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EDGEWOOD ARSENAL CONTRACTOR REPORT

EM-CR-75022

EA-5500A

EXPLOSIVE CLASSIFICATION TESTING OF PYROTECHNIC END ITEM

M-226, HC GRENADES AND LAUNCHER

By

F. L. McIntyre

July 1975

NASA NATIONAL SPACE TECHNOLOGY LABORATORIES

GENERAL ELECTRIC COMPANY

Engineering and Science Services Laboratory

Bay Saint Louis, Mississippi 39520



DEPARTMENT OF THE ARMY
Headquarters, Edgewood Arsenal
Aberdeen Proving Ground, Maryland 21010



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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER EM-CR-75022	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) EXPLOSIVE CLASSIFICATION TESTING OF PYRO- TECHNIC END ITEM M-226, HC GRENADES AND LAUNCHER		5. TYPE OF REPORT & PERIOD COVERED Final Report July 1975
		6. PERFORMING ORG. REPORT NUMBER EA-5500A
7. AUTHOR(s) F. L. McIntyre		8. CONTRACT OR GRANT NUMBER(s) MIPR B 5031 NAS8-27750
9. PERFORMING ORGANIZATION NAME AND ADDRESS NASA National Space Technology Laboratories General Electric Company Engineering & Sciences Services Laboratories Bay St. Louis, Mississippi 39520		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS PEMA 4932 Project 5754099
11. CONTROLLING OFFICE NAME AND ADDRESS Commander, Edgewood Arsenal Attn: SAREA-TS-R Aberdeen Proving Ground, MD 21010		12. REPORT DATE July 1975
		13. NUMBER OF PAGES 36
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Commander, Edgewood Arsenal Attn: SAREA-MT-TS Aberdeen Proving Ground, MD 21010 (CPO Mr. Paul Henderson, 671-2846)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A
16. DISTRIBUTION STATEMENT (of this Report) Distribution limited to U.S. Government agencies only because of test and evaluation July 1975. Other requests for this document must be referred to Commander Edgewood Arsenal, Attn: SAREA-TS-R, Aberdeen Proving Ground, Maryland 21010.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES None		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) M-226, HC Grenades and Launcher: <ul style="list-style-type: none">● Detonation Test "A"● Detonation Test "B"● External Heat Test "C"		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This document contains the results of tests performed on the M-226, HC Grenades and Launcher in accordance with U. S. Army Technical Bulletin 700-2, Change 1, Chapter 4 with the following results: Detonation Test "A" - No propagation within the single container; Detonation Test "B" - No propagation between shipping container; and External Heat Test "C" - No explosion.		

PREFACE

The work described in this report was authorized under US Army MIPR B5031 and Technical Work Request (TWR) EA 500 Rev. A. It was performed at the NASA National Space Technology Laboratories (NSTL) for the Edgewood Arsenal Resident Laboratory (EARL) and NASA-NSTL by the General Electric Company under Contract NAS8-27750. This work was initiated on March 10, 1975 and completed March 24, 1975.

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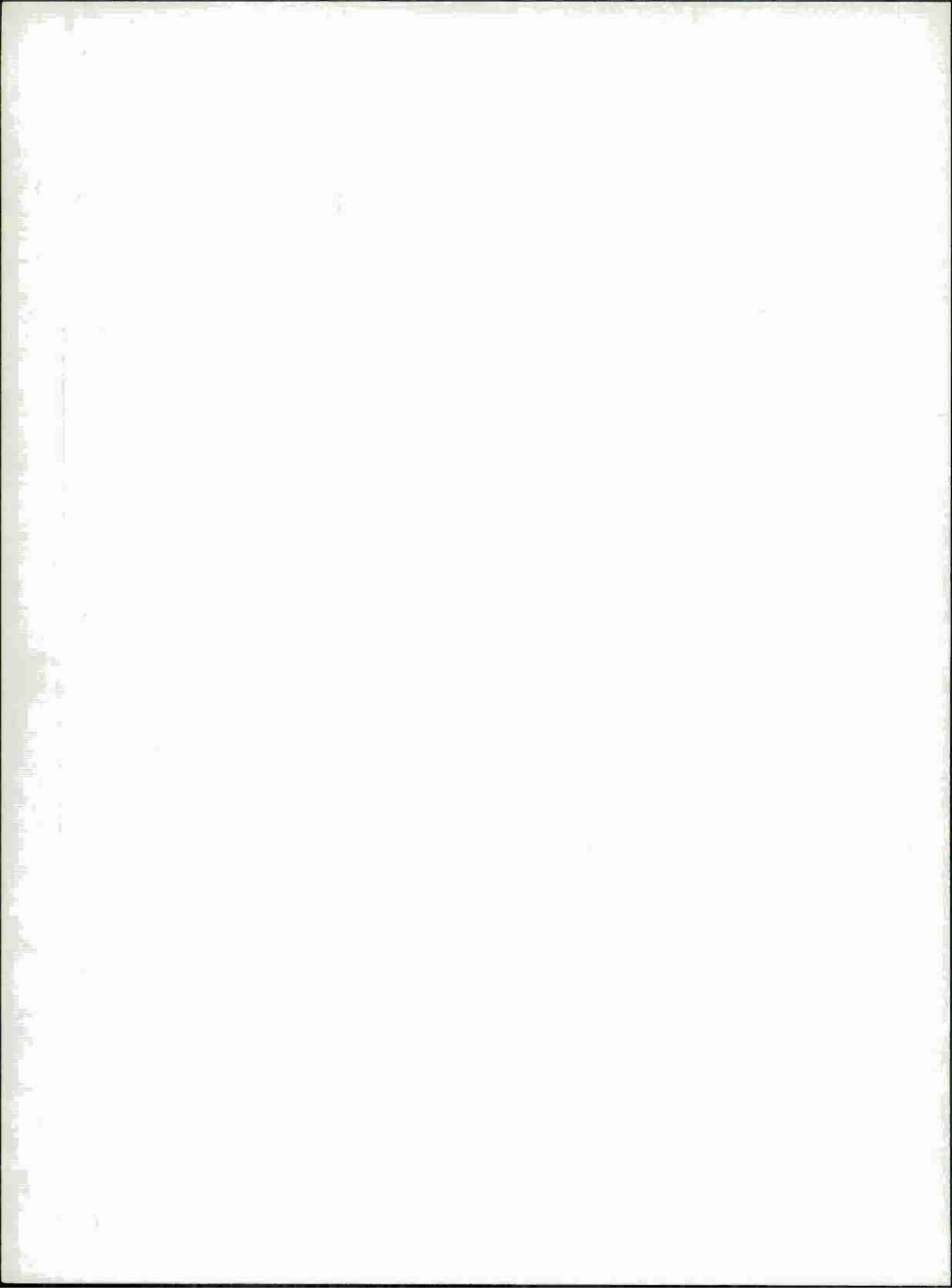
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TABLE OF CONTENTS

<u>Paragraph</u>		<u>Page</u>
1.0	INTRODUCTION	5
1.1	Objective	5
1.2	Authority	5
1.3	Background	5
2.0	TECHNICAL APPROACH	5
2.1	Background	5
2.2	End Item Munition Tests	5
2.3	Instrumentation	7
2.4	Discussion	8
3.0	RESULTS	9
3.1	Detonation Test "A" (Grenade Primed)	9
3.2	Detonation Test "A" (Self Primed)	9
3.3	Detonation Test "B" (Self Primed)	10
3.4	External Heat Test "C"	10
4.0	CONCLUSIONS	10
5.0	RECOMMENDATIONS	10
	APPENDIX A - SELECTED PHOTOGRAPHS	11
	APPENDIX B - DATA SHEETS AND CHRONOLOGY OF EVENTS	19
	DISTRIBUTION LIST	35

LIST OF ILLUSTRATIONS

<u>Figure No.</u>		<u>Page</u>
1	Priming of Donor Round	6
2	Location of Donor Round in Container	6
3	Self Priming of Tests A & B Configuration Using Pendulum Striker	7
4	Typical Blast Overpressure Measurement Transducer Placement for Detonation Test "A"	8
5	Typical Motion Picture Camera Set-Up for Detonation Tests A & B and External Heat Test C	9



EXPLOSIVE CLASSIFICATION TESTING OF PYROTECHNIC END ITEM
M-226, HC GRENADES AND LAUNCHER

1.0 INTRODUCTION

1.1 Objective. The objective of this study was to provide results of the M-226, HC Grenades and Launcher tendency to propagate within a single shipping container, between shipping containers, and the reaction resulting from burning the munitions in an intense fire. The specific tests delineated in TB 700-2, Change 1, Chapter 4 were:

- Detonation Test "A"
- Detonation Test "B"
- External Heat Test "C"

1.2 Authority. The work described in this report was authorized by TWR EA-5500A, Task 3.

1.3 Background. Evaluation of pyrotechnic end item munitions is currently accomplished through test data obtained from specific tests performed in accordance with Chapter 4, TB 700-2. Chapter 4 provides test requirements for pyrotechnic end item munitions manufactured, packaged, and ready for field use.

The results of tests may be utilized by cognizant Department of Defense/Department of Transportation agencies to assign hazards classification and compatibility for transportation and storage of end item munitions.

2.0 TECHNICAL APPROACH

2.1 Background. The M-226 grenades and launcher assembly comprises two AN-M8, HC grenades placed in a sabot inside the launcher and is primed by a M29A1 percussion primer which in turn initiates the M-225 propulsion cartridge. A total of eight assemblies are then placed in packing composed of a molded polystyrene inner and outer cell with plastic foam per Drawing Number D13-12-22-23 and bound in a wirebound wooden box per PPP-B-585, Type I, Class 3, Style 2. Twenty of these boxes are placed on a pallet per Drawing D13-12-30 and readied for shipment.

For the purpose of this report, the shipping configuration is defined as a single wire-bound container.

2.2 End Item Munition Tests. Detonation test "A", was conducted on the assembly of the M-226, HC grenades and launcher in the single container configuration to determine if functioning of one grenade would cause additional launchers within the container to function. The grenade furthestmost from the propelling cartridge within the launcher was primed with an electric match head igniter. The donor round was located in the bottom row of the inner

cell (see figures 1 and 2 for method of priming and donor location).

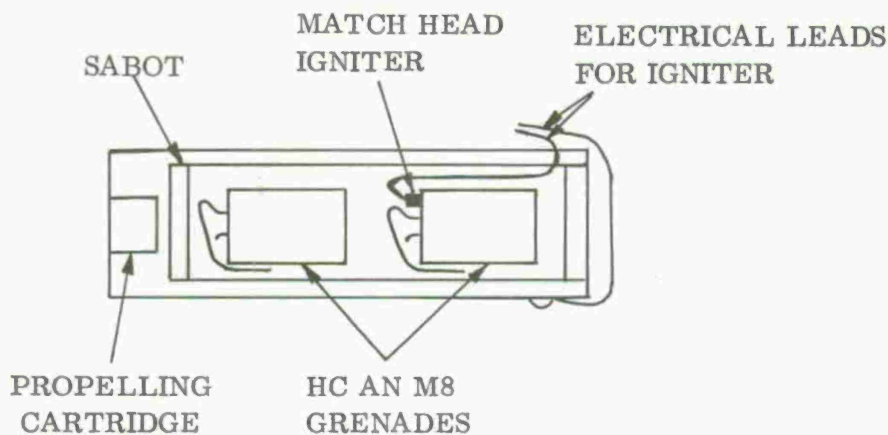


Figure 1. Priming of Donor Round

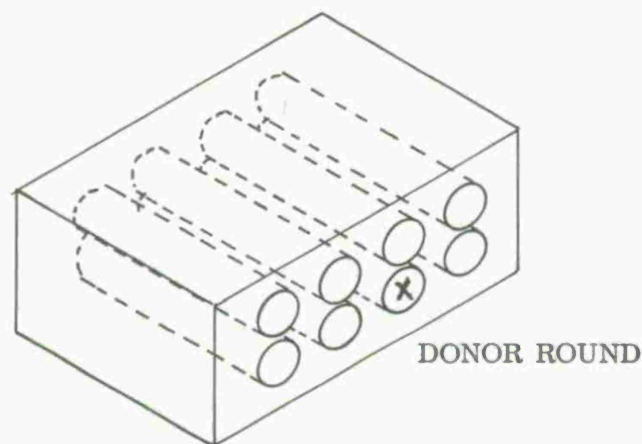


Figure 2. Location of Donor Round in Container

The test was conducted five times to determine:

- Propagation between donor and acceptor rounds
- Blast overpressure
- Fragmentation dispersal from container rupture.

An additional test was conducted by initiating the M29A1 percussion primer with a striker. The test setup is shown in figure 3. The donor round was located in the bottom row of the inner cell.

Detonation test "B" was conducted on the M-226, HC grenades and launcher in a multiple container configuration to determine if functioning of donor launcher and grenades would result in functioning of the donor grenades and or communication to the adjacent containers. The donor round was initiated by striking the M29A1 percussion primer in a manner similar

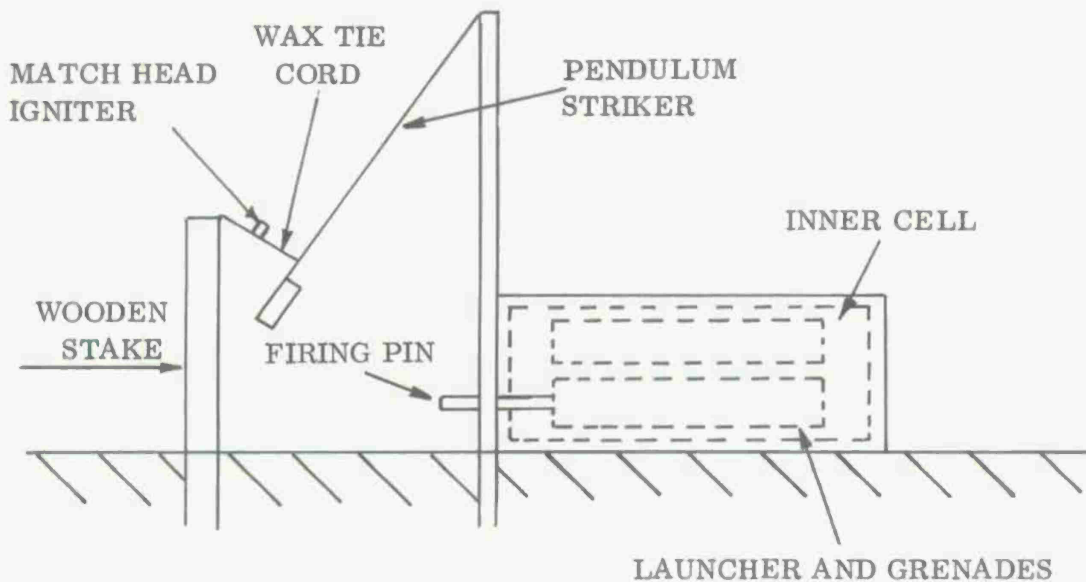


Figure 3. Self Priming of Tests A & B Configuration Using Pendulum Striker

to that described in the "A" test configuration (figure 3). The acceptor container was positioned in a manner which provided minimum separation between donor and acceptor launchers in the two packing containers. The test was conducted to determine if propagation between containers occurred, if the donor grenades functioned, and if fire and fragmentation hazards were evident.

External heat test "C" (open flame) is designed to simulate a condition where four single packing containers of M-226, HC grenades and launcher are completely enveloped in a hot flame. The four containers were arranged to approximate a cube. The stack of four containers was placed in a crib of wood approximately 30 inches high. The interior of the crib was filled with scrap lumber. The crib and stack of M-226, HC grenades and launcher were then covered by additional scrap lumber and doused with 55 gallons of diesel fuel. Ignition was effected by two electric match head igniters, each boosted with 10 grains of UTC 3001 propellant, placed on opposite sides of the crib base. This test was performed to determine if an explosion would result from the intense heat or open flame.

2.3 Instrumentation. A total of four (each) Susquehanna ST-7 piezoelectric transducers were deployed in a 90 degree array at a distance of 15.6 feet from the center of the end item munition assembly, with an expected blast overpressure of five. The transducers and Blomation recorders were calibrated for five psig full-scale with the trigger levels of the Blomations set at 0.5 psig to record the minimum required pressure. Typical transducer placement is shown in figure 4. In the event of blast overpressure occurring as the result of the M-226, HC grenades and launcher functioning, the blast overpressure profile would be mapped in accordance with guidelines set forth in Chapter 2, Paragraph 4a of TB 700-2.

Twenty-four frames per second, documentary colored motion pictures were taken during each test with a Mitchell camera placed approximately 150 feet from the test end item with

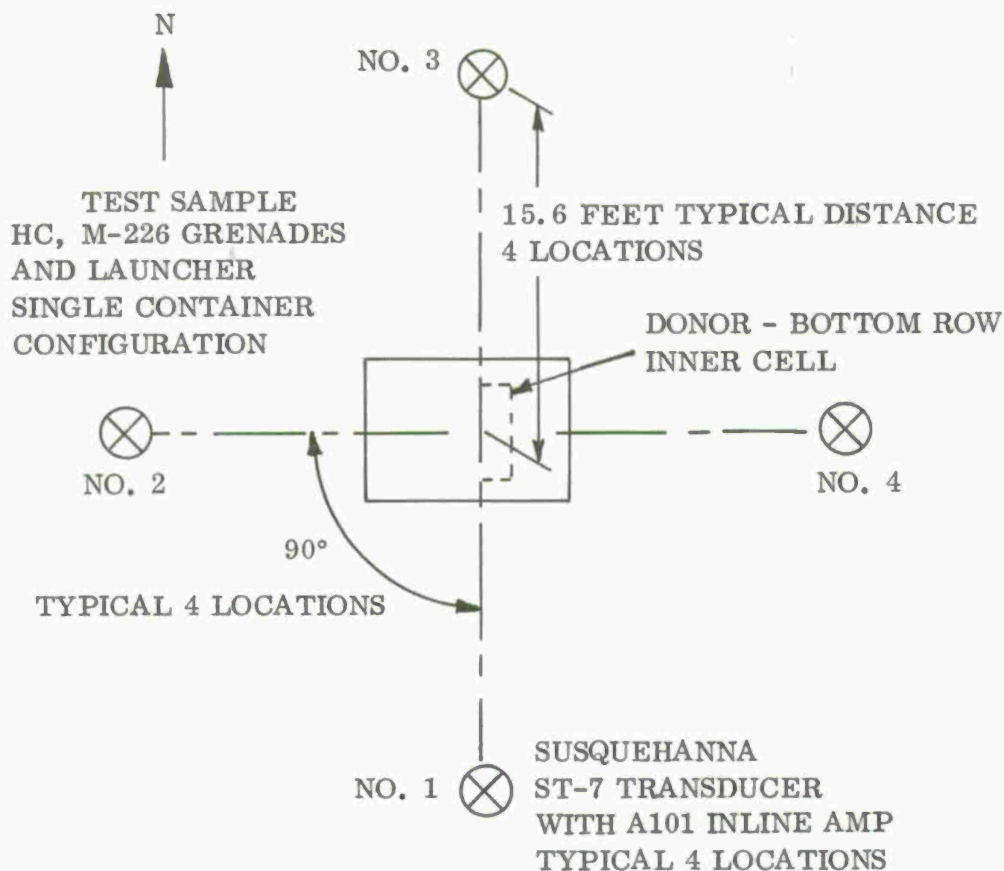


Figure 4. Typical Blast Overpressure Measurement Transducer Placement for Detonation Test "A"

a viewing area of 25 feet either side of box. Figure 5 shows a typical motion picture setup for detonation tests "A", "B", and external heat test "C". Before and after still black and white photographs were taken of setup priming and results and are included in this report, as appendix A.

2.4 Discussion. While preparing the donor rounds for test, it was noted that two possible hazardous conditions could exist:

- The percussion primer, though recessed in the round, is exposed to possible sharp pointed object that upon impact could function as normally intended.
- Since the launcher is constructed of an insulator material, the primer and grenade are insulated from one another, and the launchers are packaged in a styrofoam-type packing, it is conceivable that an electrostatic charge can be developed.

The discharge paths, however, can occur only through the exposed primer at one end of the launcher and the metal cap at the opposite end of the primer. Further tests may be warranted to determine electrostatic sensitivity.

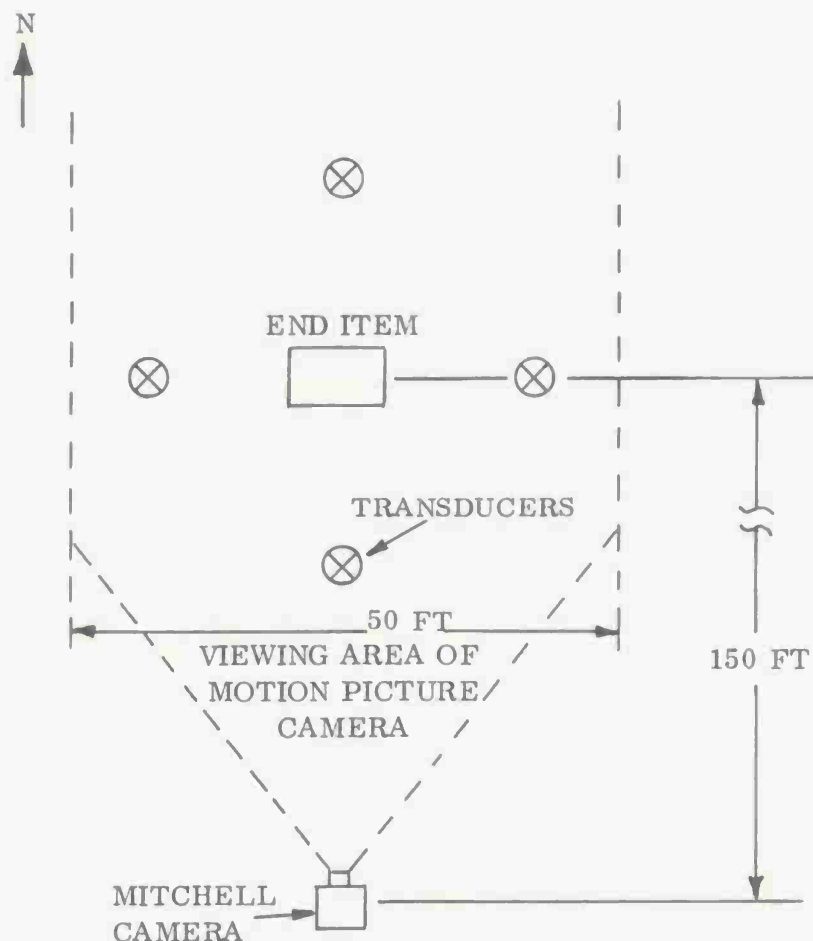


Figure 5. Typical Motion Picture Camera Set-Up for Detonation Tests A & B and External Heat Test C

3.0 RESULTS

3.1 Detonation Test "A" (Grenade Primed). The assembly of the M-226, HC grenades and launcher in the single packing container configuration was subjected to five (each) standard end item detonation tests "A". The AN-M8 HC white smoke grenade furthest from the M29A1 percussion primer was initiated utilizing an electric match head igniter. In each case, the donor grenade functioned, propagated to the second grenade in the launcher, but failed to propagate to the next launcher within the container. There was no measurable blast overpressure (more than 0.5 psig) at a distance of 15.6 feet, nor was there any discernible report from functioning. Therefore, this test series precluded the need for standard end item detonation test "B" discussed in the next paragraph.

3.2 Detonation Test "A" (Self Primed). The assembly of M-226, HC grenades and launcher in the single packing container was subjected to a single standard end item detonation test "A". The M29A1 percussion primer was initiated by the pendulum striker to approximate conditions of rough handling. The test resulted in the functioning of the launcher, a hole in the box approximately 4 inches in diameter in front of the launcher, and the grenade

being propelled 28 and 41 feet, respectively. The two grenades functioned in a normal manner. Appendix B presents the diagram of results. There was no measurable overpressure greater than 0.5 psig at 15.6 feet. This test was conducted only once as defined by interpretation of test results per TB 700-2, i.e., damage to packing containers dictates that detonation test "B" be performed.

3.3 Detonation Test "B" (Self Primed). The assembly of the M-226, HC grenades and launcher was subjected to a single standard end item detonation test "B". The test was conducted by functioning the M29A1 percussion primer with the pendulum striker. The test resulted in no functioning of the grenades, no communication or propagation between containers, and no outside damage to the donor box. Based upon the test results and with approval of the Edgewood Safety Representative/Project Engineer, no additional detonation tests "B" were performed.

3.4 External Heat Test "C". Four (each) wirebound containers were placed inside of a pyre, doused with 55 gallons of diesel fuel in accordance with Chapter 4, Table 6 of TB 700-2, and consumed by intense heat. No explosion or expulsion of any of the grenades resulted from the exposure to the pyre.

4.0 CONCLUSIONS

The results of these tests on the assembly of the M-226, HC grenades and launcher indicate that no propagation occurred within the packing container, between packing containers, and no explosion resulted when subjected to intense heat and open flame.

5.0 RECOMMENDATIONS

Further tests should be performed to evaluate the electrostatic sensitivity of the M-226 rounds when packaged in the specified electrically insulating material.

APPENDIX A
SELECTED PHOTOGRAPHS

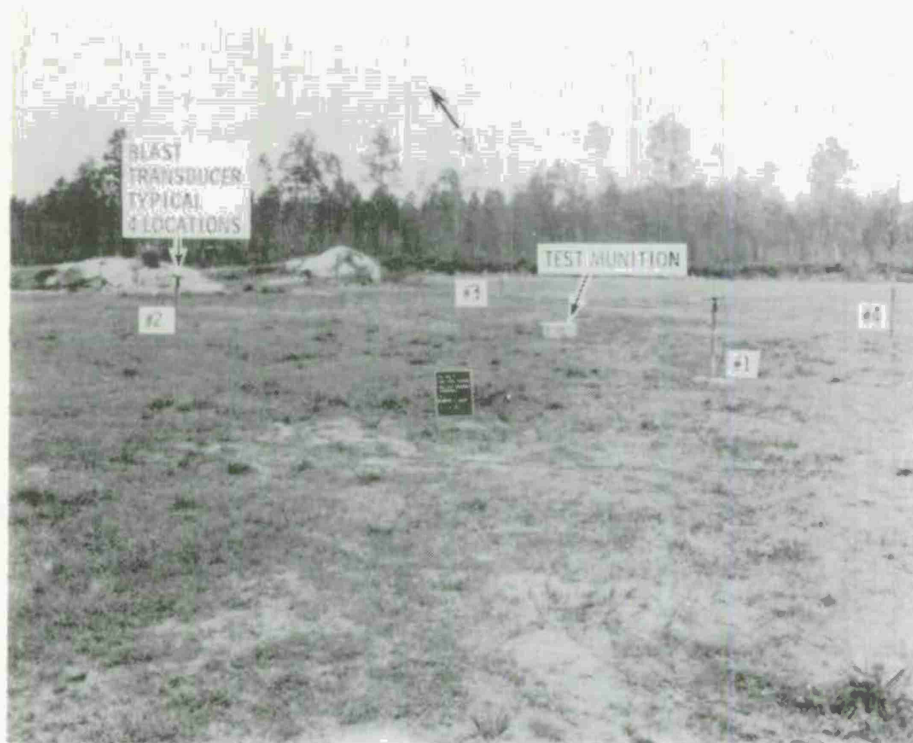
The photographs appearing in this Appendix were selected as being representative of the photographic documentation obtained in pre-test and post-test photographs.



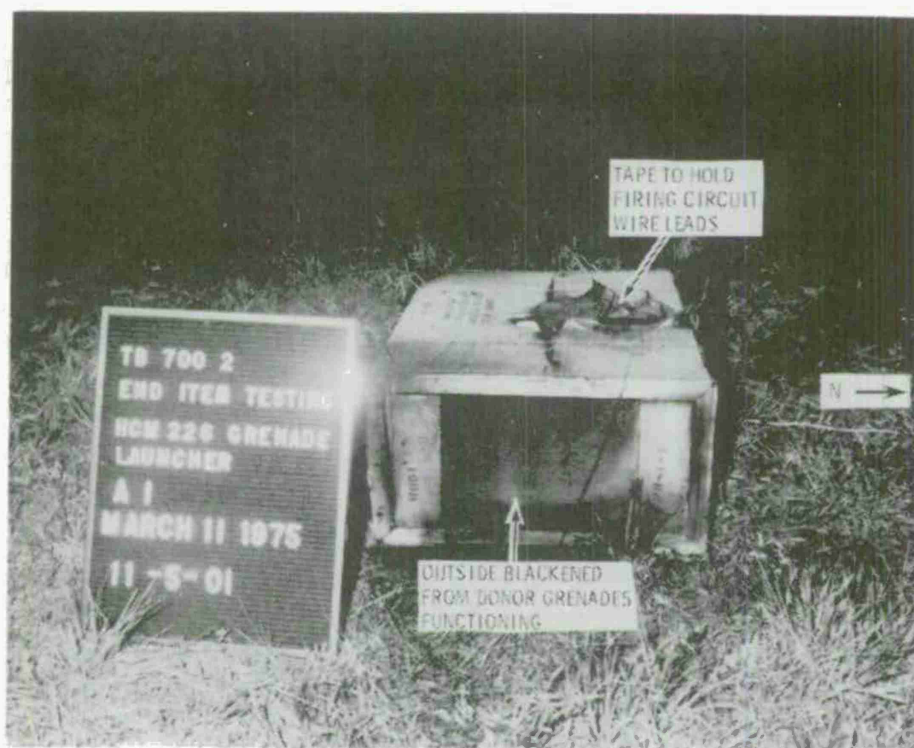
Typical Test Setup for a Standard TB700-2 End Item Detonation Test "A"



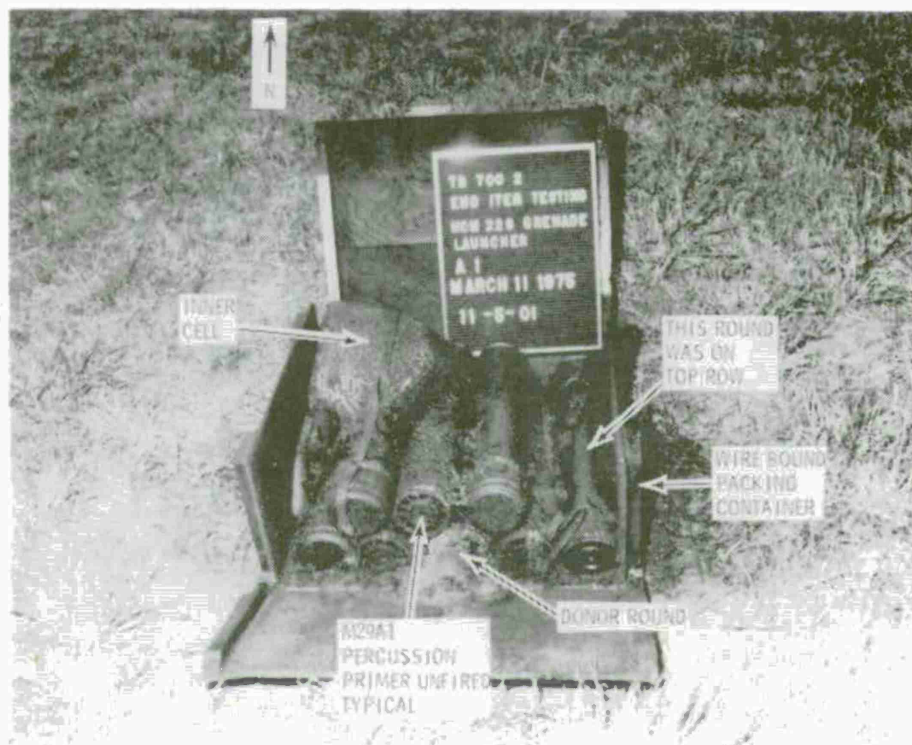
Typical Donor Location for End Item Detonation Test "A"



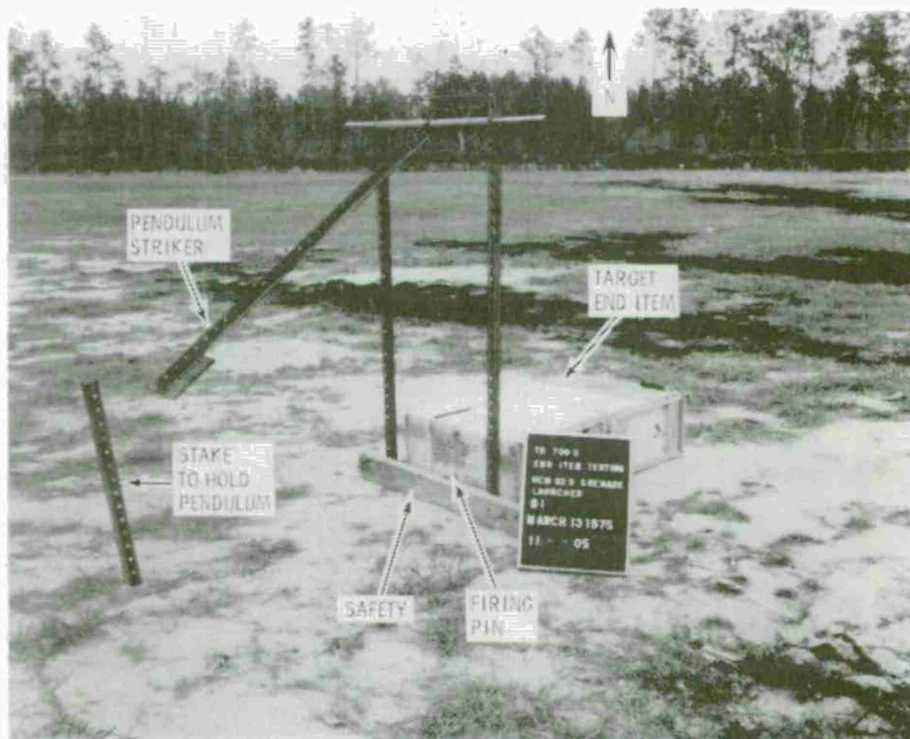
Typical Instrumentation Setup Showing Transducer Locations at 15.6 Feet - 90° Array



Typical Results of Detonation Test "A" Showing Outside of Packing Crate



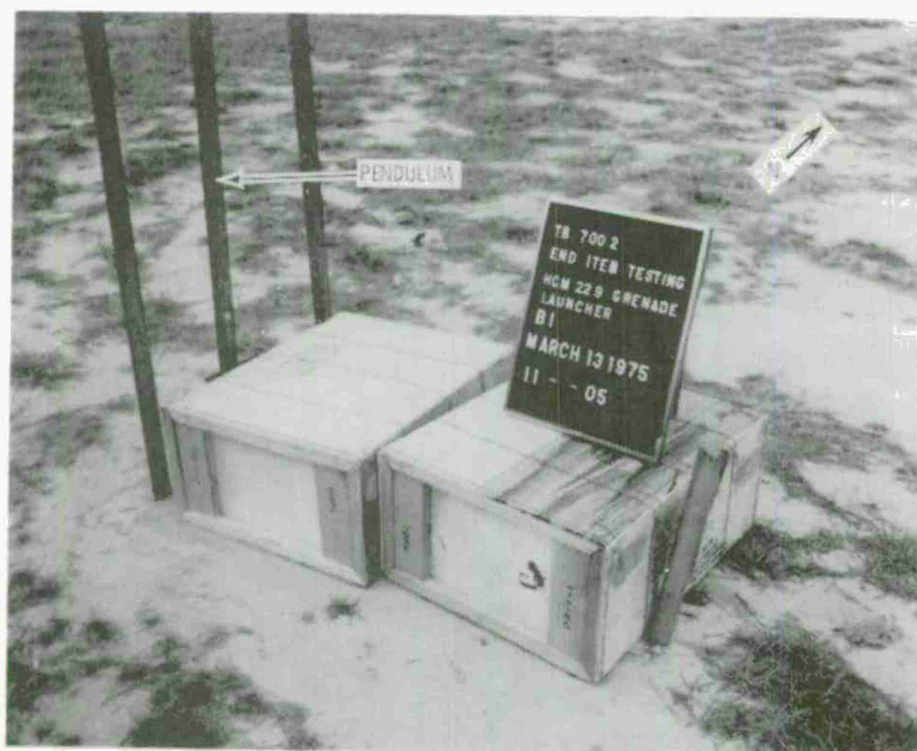
Typical Results of Detonation Test "A" Showing Interior of Packing Crate



Typical Set up for Self-Primed Detonation Tests "A" and "B" Using Pendulum Striker



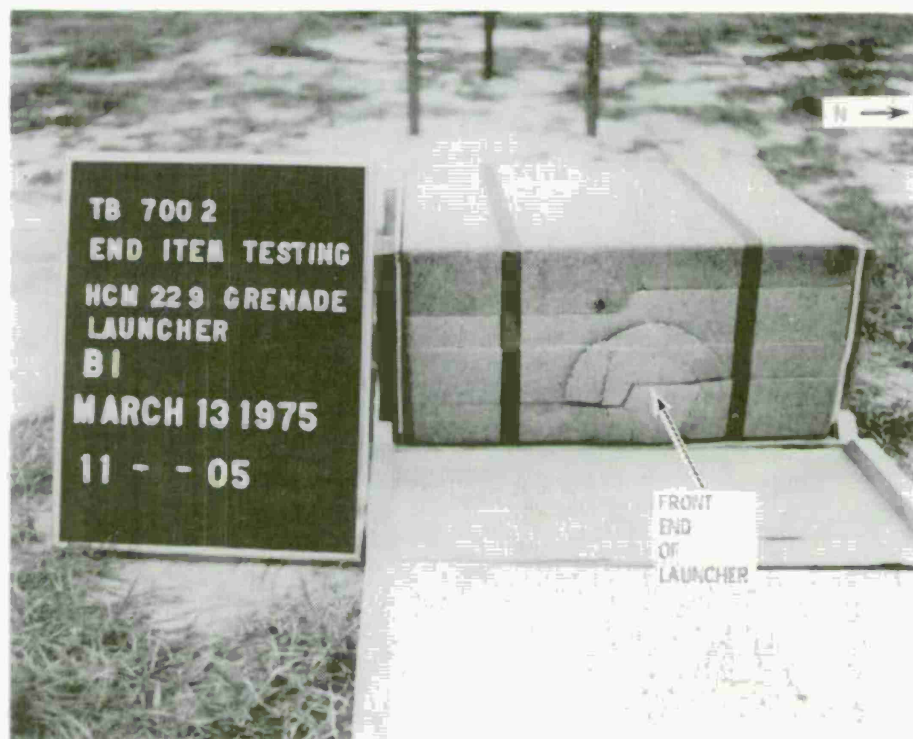
Test Results of Self-Primed Detonation Test "A"



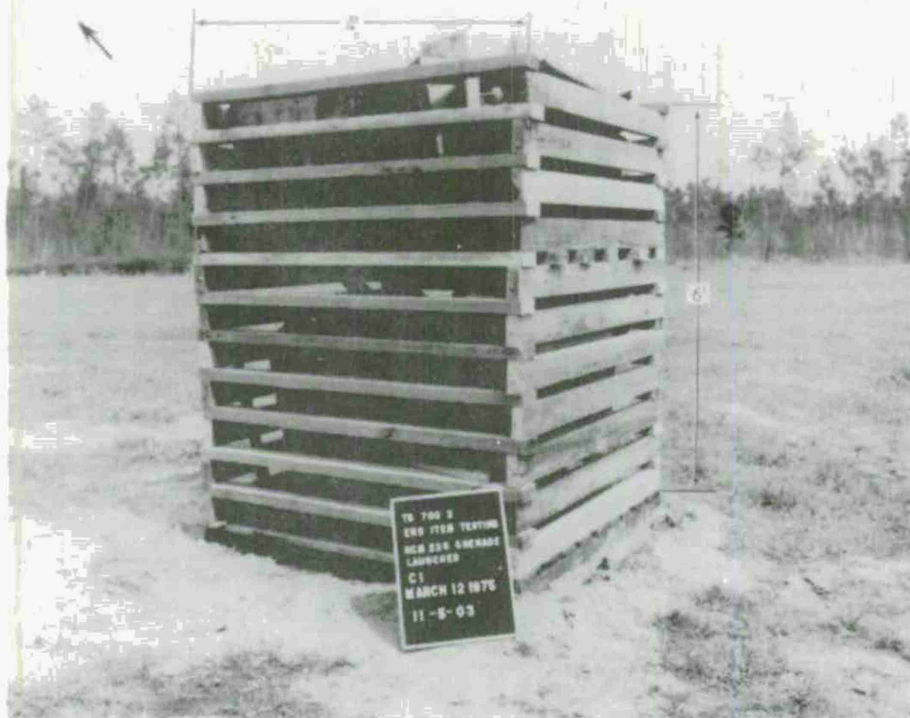
Result of Self-Primed Detonation Test "B" Showing Exterior of Packing Crate



Results of Self-Primed Detonation Test "B" Showing Inner Cell at Ignition Source



Results of Self-Primed Detonation Test "B" Showing Inner Cell of Launcher Tube



Typical Test Setup for End Item External Heat Test "C"



Results of External Heat Test "C" - No Grenades or Launchers Outside of Pyre

APPENDIX B
DATA SHEETS AND CHRONOLOGY OF EVENTS

Test Type Standard TB 700-2 Detonation A Test		Date 3/11/75	
Sponsoring Agent Edgewood Arsenal, Edgewood, Maryland		Test Number 11-5-01	
Contract Number NAS8-27750		Designation HC, M226 Rocket Launcher	
Specification 1330-00-103-0694		Drawing Number N/A	
Lot Number PB1-1		Manufacture Date 12/74	
METEOROLOGICAL DATA			
Temperature 76° F	Humidity 79%	Barometric Pressure 29.91	
Wind Direction 140°		Wind Velocity 12 Knots	
TEST SET UP			
Priming Match Head Igniter		Location of Donor Bottom Row 2nd from right box oriented north	
Booster None		Confinement None	
TEST RESULTS			
Detonation Test A		Detonation Test B	
Propagation Yes _____ No X		Propagation Yes _____ No _____	
Attachments Photo X Map _____ Blast Press. _____		Attachments Photo _____ Map _____ Blast Press. _____	
Test Conductor		Project Engineer F. L. McIntyre	
		Test Dept. Head	

Assigned Classification

ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

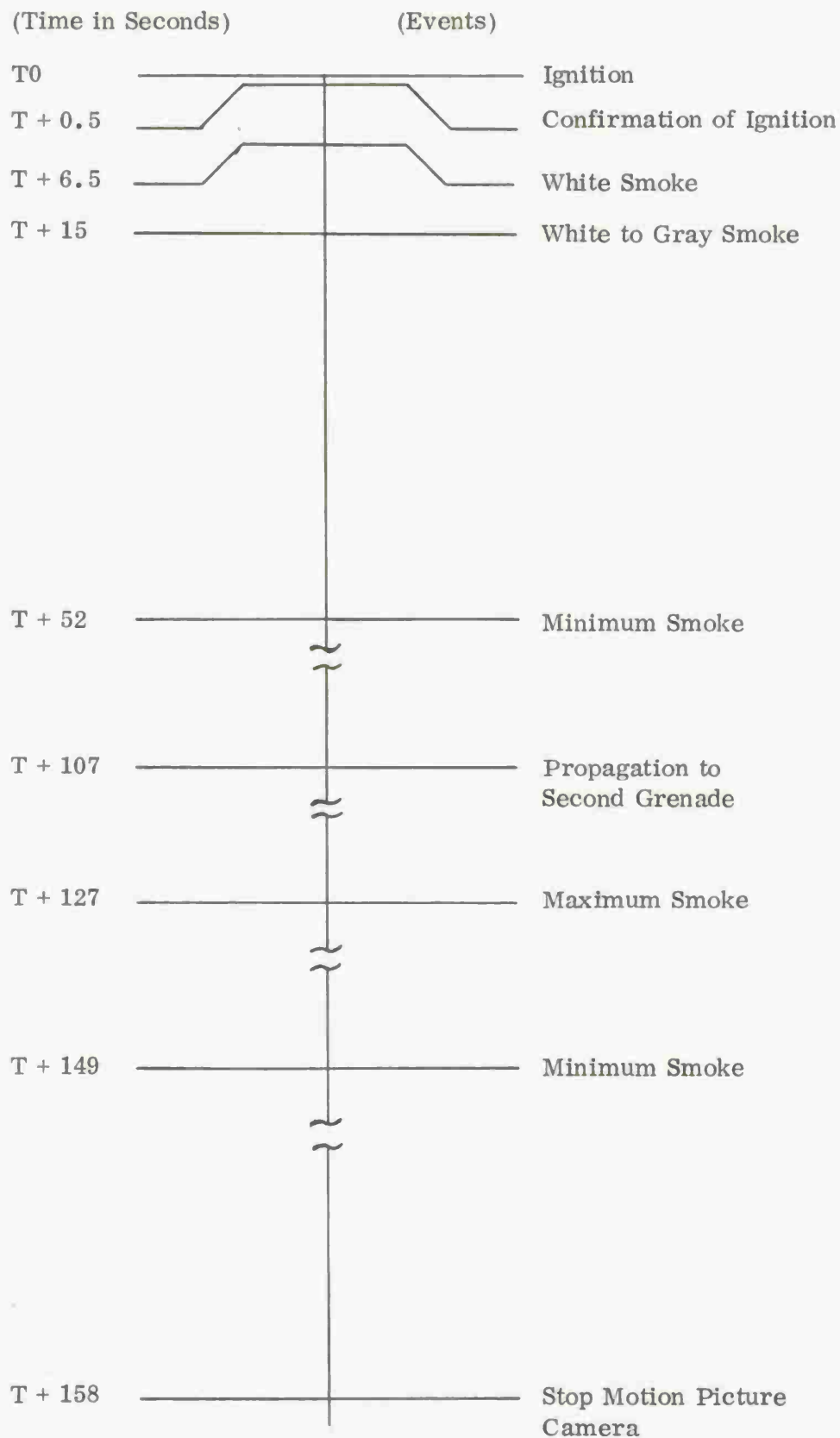
Signature

Title

Organization

*Shipping instructions are to be obtained from ICC Para. 3-13A(2)

CHRONOLOGY OF EVENTS
 HC, M-226, GRENADES AND LAUNCHER
 TEST NUMBER 11-5-01, DETONATION TEST "A"



Test Type Standard TB 700-2 Detonation "A" Test		Date 3/12/75	
Sponsoring Agent Edgewood Arsenal, Edgewood, Maryland		Test Number 11-5-02B	
Contract Number NAS8-27750		Designation HC, M226 Rocket Launcher	
Specification 1330-00-103-0694		Drawing Number N/A	
Lot Number PBI-1		Manufacture Date 12/74	
METEOROLOGICAL DATA			
Temperature 76°F	Humidity 70%	Barometric Pressure 29.82	
Wind Direction 150°		Wind Velocity 11 Knots	
TEST SET UP			
Priming Match Head Igniter		Location of XXXXXXXX Bottom row second from Donor right (box oriented true north)	
Booster None		Confinement None	
TEST RESULTS			
Detonation Test A *		Detonation Test B	
Propagation Yes _____ No <u>X</u>		Propagation Yes _____ No _____	
Attachments Photo _____ Map _____ Blast Press. _____		Attachments Photo _____ Map _____ Blast Press. _____	
Test Conductor		Project Engineer F. L. McIntyre	
		Test Dept. Head	

*Impulse cartridge functioned.

Assigned Classification

ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

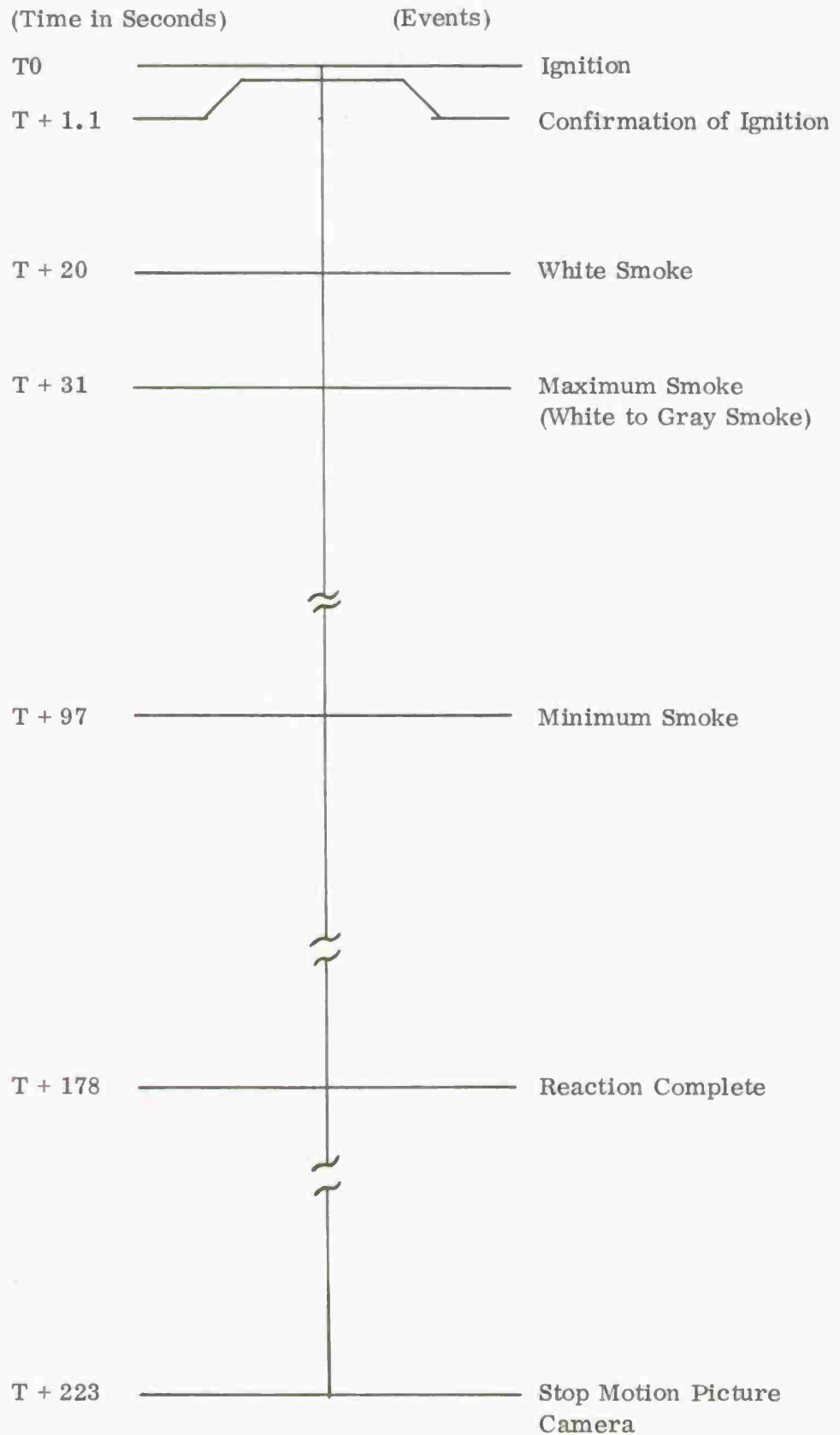
Signature

Title

Organization

*Shipping instructions are to be obtained from ICC Para. 3-13A(2)

CHRONOLOGY OF EVENTS
 HC, M-226, GRENADES AND LAUNCHER
 TEST NUMBER 11-5-02B, DETONATION TEST "A"



Test Type Standard TB 700-2 Detonation "A" Test		Date 3/12/75	
Sponsoring Agent Edgewood Arsenal, Edgewood, Maryland		Test Number 11-5-02C	
Contract Number NAS8-27750		Designation HC, M226 Rocket Launcher	
Specification 1330-00-103-0694		Drawing Number N/A	
Lot Number PB-1		Manufacture Date 12/74	
METEOROLOGICAL DATA			
Temperature 76 ⁰ F	Humidity 70%	Barometric Pressure 29.82	
Wind Direction 150 ⁰		Wind Velocity 11 Knots	
TEST SET UP			
Priming Match Head Ignitor		Location of XXXXXXXX Donor Bottom row 2nd from right (box oriented north)	
Booster None		Confinement None	
TEST RESULTS			
Detonation Test A		Detonation Test B	
External Heat Test "C"			
Propagation		Propagation	
Explosion			
Yes No X*		Yes No	
Attachments Photo <u> X </u> Map <u> </u> Blast Press. <u> </u>		Attachments Photo <u> </u> Map <u> </u> Blast Press. <u> </u>	
Test Conductor		Project Engineer F. L. McIntyre	
		Test Dept. Head	

*Box caught fire from grass fire and all rounds functioned approximately 1 hr. after test.

Assigned Classification

ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

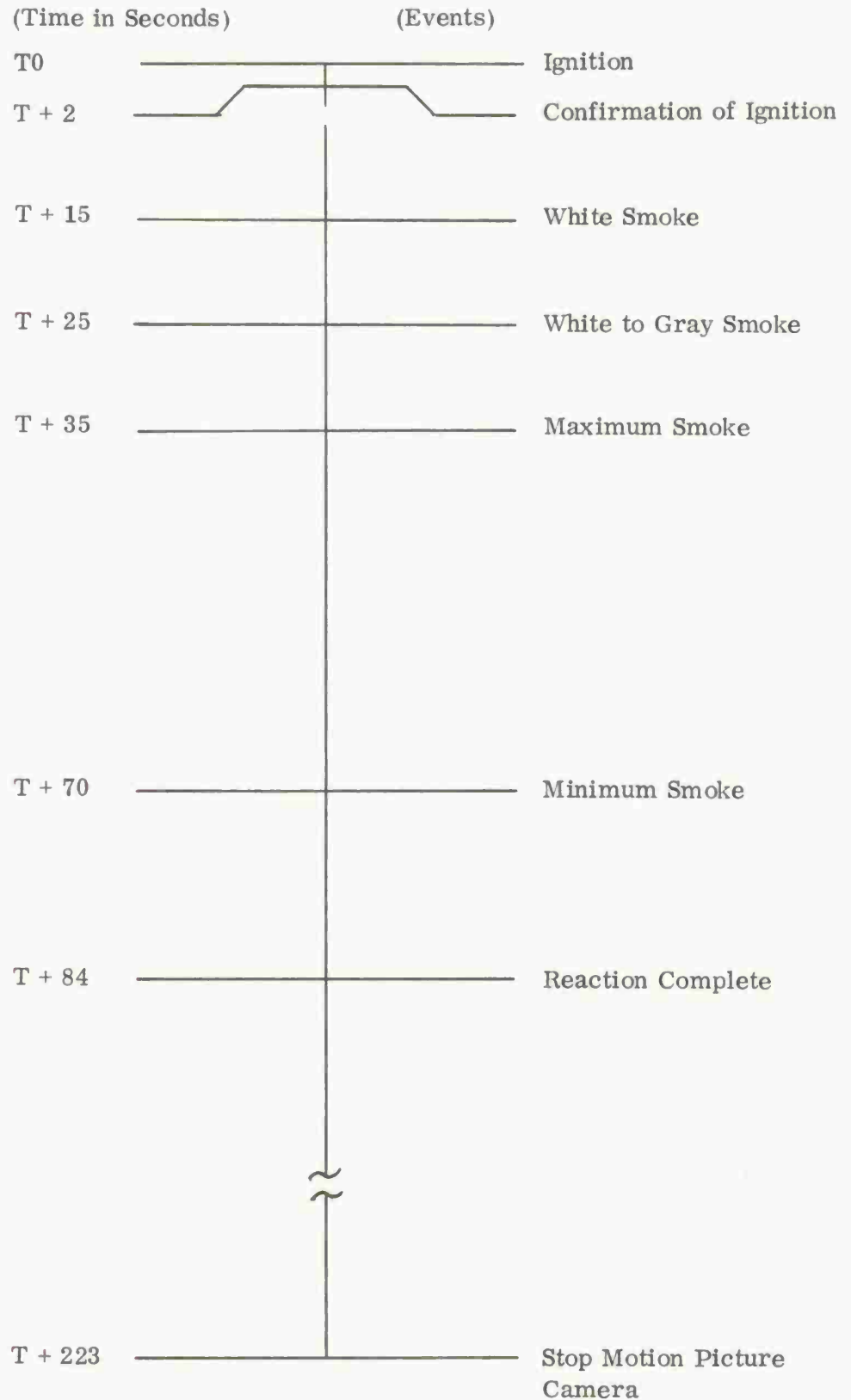
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Title

Organization

*Shipping instructions are to be obtained from ICC Para: 3-13A(2)

CHRONOLOGY OF EVENTS
 HC, M-226, GRENADES AND LAUNCHER
 TEST NUMBER 11-5-02C, DETONATION TEST "A"



Test Type Standard TB 700-2 Detonation "A" Test		Date 3/12/75	
Sponsoring Agent Edgewood Arsenal, Edgewood, Maryland		Test Number 11-5-02D	
Contract Number NAS8-27750		Designation HC, M226 Rocket Launcher	
Specification 1330-00-103-0694		Drawing Number N/A	
Lot Number PBI-1		Manufacture Date 12/74	
METEOROLOGICAL DATA			
Temperature 76°F	Humidity 70%	Barometric Pressure 29.82	
Wind Direction 150°		Wind Velocity 11 Knots	
TEST SET UP			
Priming Match Head Ignitor		Location of Accept Donor Bottom Row 2nd from right (box oriented north)	
Booster None		Confinement None	
TEST RESULTS			
Detonation Test A*		Detonation Test B	
Propagation Yes No <u>X</u>		Propagation Yes No <u> </u>	
Attachments Photo <u> X </u> Map <u> </u> Blast Press. <u> </u>		Attachments Photo <u> </u> Map <u> </u> Blast Press. <u> </u>	
Test Conductor		Project Engineer F. L. McIntyre	
		Test Dept. Head	

*After approximately 1 hr. box caught fire and rounds propagated.

Assigned Classification

ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

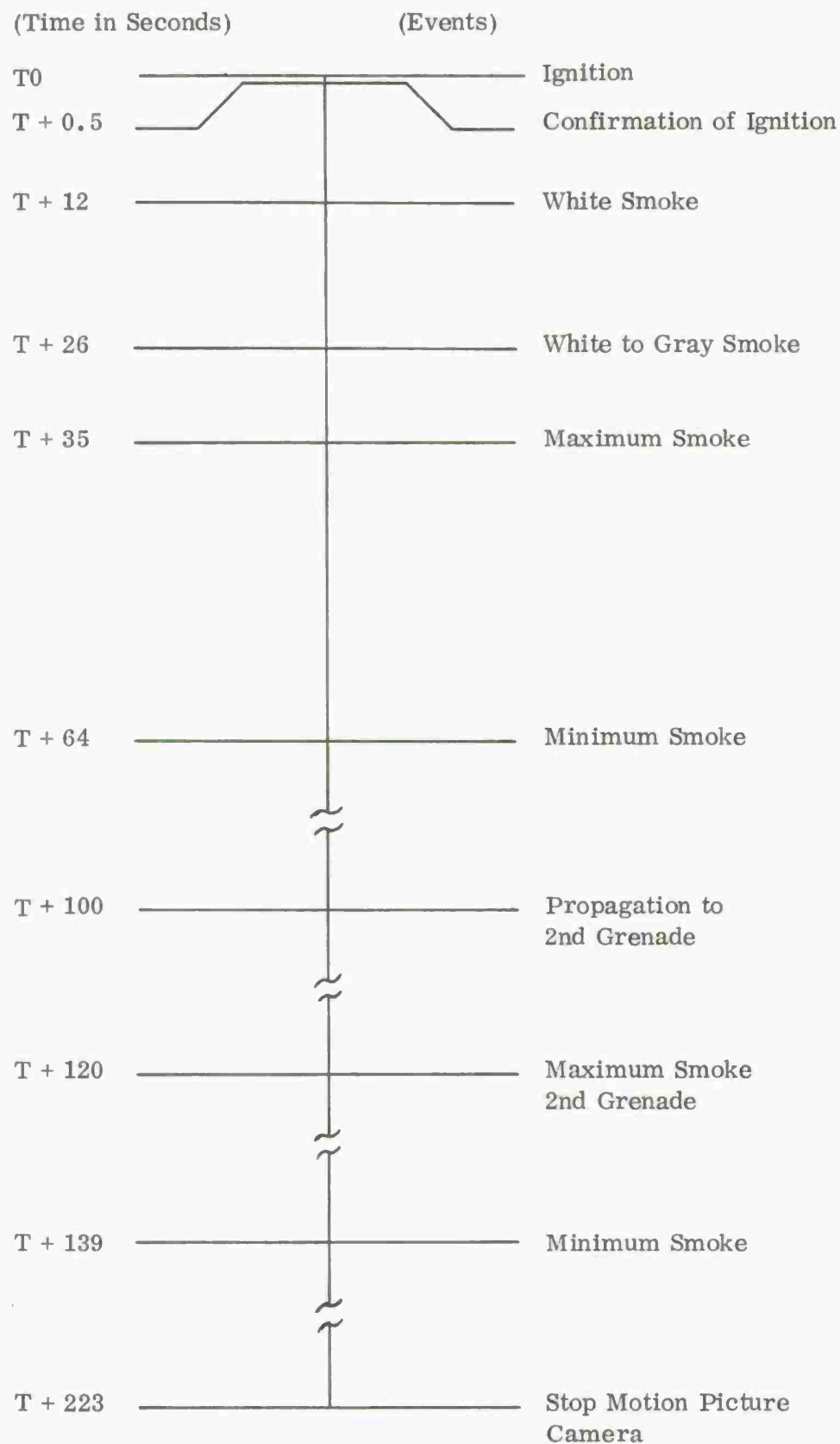
Signature

Title

Organization

*Shipping instructions are to be obtained from ICC Para. 3-13A(2)

CHRONOLOGY OF EVENTS
 HC, M-226, GRENADES AND LAUNCHER
 TEST NUMBER 11-5-02D, DETONATION TEST "A"



Test Type Standard TB 700-2 Detonation "A" Test		Date 3/12/75	
Sponsoring Agent Edgewood Arsenal, Edgewood, Maryland		Test Number 11-5-02E	
Contract Number NAS8-27750		Designation HC, M226 Rocket Launcher	
Specification 1330-00-103-0694		Drawing Number N/A	
Lot Number PB1-1		Manufacture Date 12/74	
METEOROLOGICAL DATA			
Temperature 76°F	Humidity 70%	Barometric Pressure 29.82	
Wind Direction 150°		Wind Velocity 11 Knots	
TEST SET UP			
Priming Match Head Ignitor		Location of Acceptor Donor Bottom Row 2nd from right (box oriented north)	
Booster None		Confinement None	
TEST RESULTS			
Detonation Test A *		Detonation Test B	
External Heat Test "C"			
Propagation		Propagation	
Explosion			
Yes No X		Yes No	
Yes No		Yes No	
Attachments Photo Map Blast Press. X		Attachments Photo Map Blast Press. _____	
Attachments Photo Map Blast Press. _____		Attachments Photo Map Blast Press. _____	
Test Conductor		Project Engineer F. L. McIntyre	
		Test Dept. Head	

*Impulse cartridge functioned.

Assigned Classification

ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

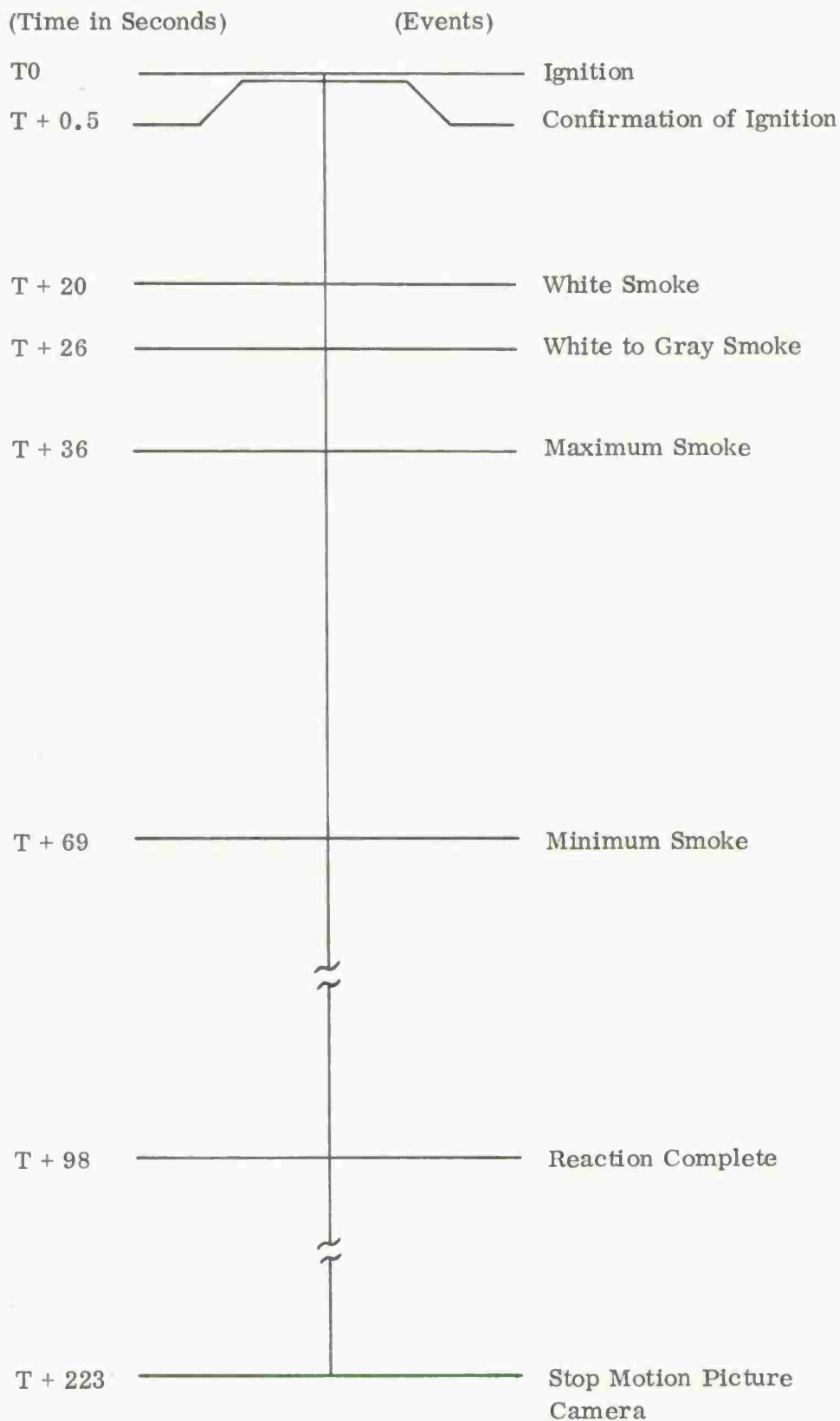
Signature

Title

Organization

*Shipping instructions are to be obtained from ICC Para. 3-13A(2)

CHRONOLOGY OF EVENTS
 HC, M-226, GRENADES AND LAUNCHER
 TEST NUMBER 11-5-02E, DETONATION TEST "A"



Test Type Standard TB 700-2 External Heat Test "C"		Date 3/12/75
Sponsoring Agent Edgewood Arsenal, Edgewood, Maryland		Test Number 11-5-03
Contract Number NAS8-27750	Designation HC, M226 Rocket Launcher	
Specification 1300-00-103-0694	Drawing Number N/A	
Lot Number PB1-1	Manufacture Date 12/74	
METEOROLOGICAL DATA		
Temperature 81°F	Humidity 58%	Barometric Pressure 29.82
Wind Direction 170°	Wind Velocity 14 Knots	
TEST SET UP		
Priming 55 gal. of diesel fuel and match head ignitor	Location of Acceptor 4 boxes placed inside pyro	
Booster None	Confinement None	
TEST RESULTS		
Detonation Test A	Detonation Test B	External Heat Test "C"
Propagation	Propagation	Explosion
Yes No	Yes No	Yes No X
Attachments Photo _____ Map _____ Blast Press. _____	Attachments Photo _____ Map _____ Blast Press. _____	Attachments Photo <u>X</u> _____ Map _____ Blast Press. _____
Test Conductor	Project Engineer F. L. McIntyre	Test Dept. Head

Assigned Classification

ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

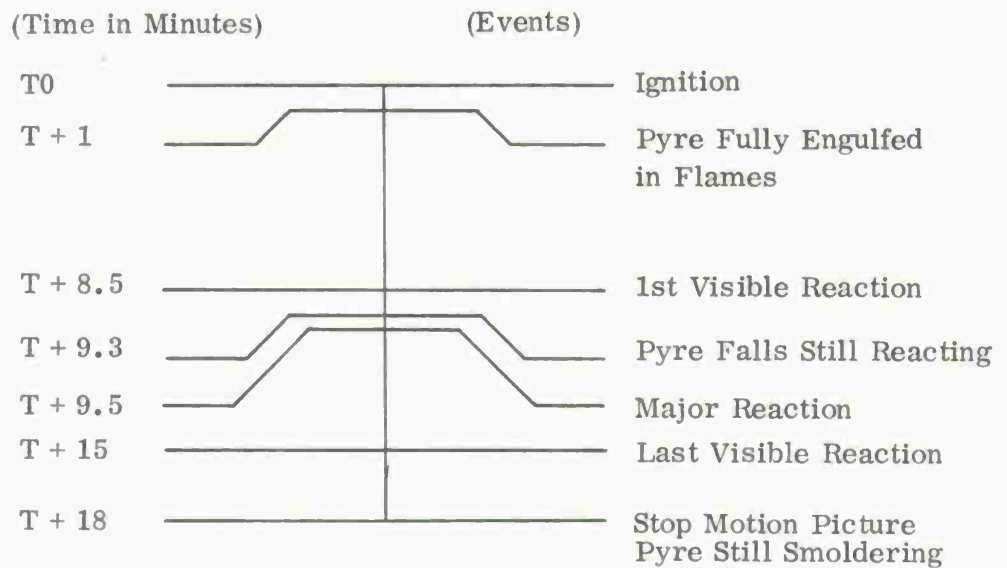
Signature

Title

Organization

*Shipping instructions are to be obtained from ICC Para. 3-13A(2)

CHRONOLOGY OF EVENTS
 HC, M-226, GRENADES AND LAUNCHER
 TEST NUMBER 11-5-03, EXTERNAL HEAT TEST "C"



Test Type Standard TB 700-2 Detonation A Test*		Date 11-13-75	
Sponsoring Agent Edgewood Arsenal, Edgewood, Maryland		Test Number 11-5-04	
Contract Number NAS8-27750		Designation HC, M226 Rocket Launcher	
Specification 1330-00-103-0694		Drawing Number N/A	
Lot Number PB1-1		Manufacture Date 12/74	
METEOROLOGICAL DATA			
Temperature 76°F	Humidity 76%	Barometric Pressure 29.66	
Wind Direction 150°		Wind Velocity 15 Knots	
TEST SET UP			
Priming Self		Location of Donor 2nd from left bottom row (round oriented north)	
Booster None		Confinement None	
TEST RESULTS			
Detonation Test A		Detonation Test B	
Propagation Yes No X		Propagation Yes No	
Attachments Photo X Map X Blast Press.		Attachments Photo Map Blast Press.	
Test Conductor		Project Engineer F. L. McIntyre	
		Test Dept. Head	

*Self primed impact of M29A1 percussion primer.

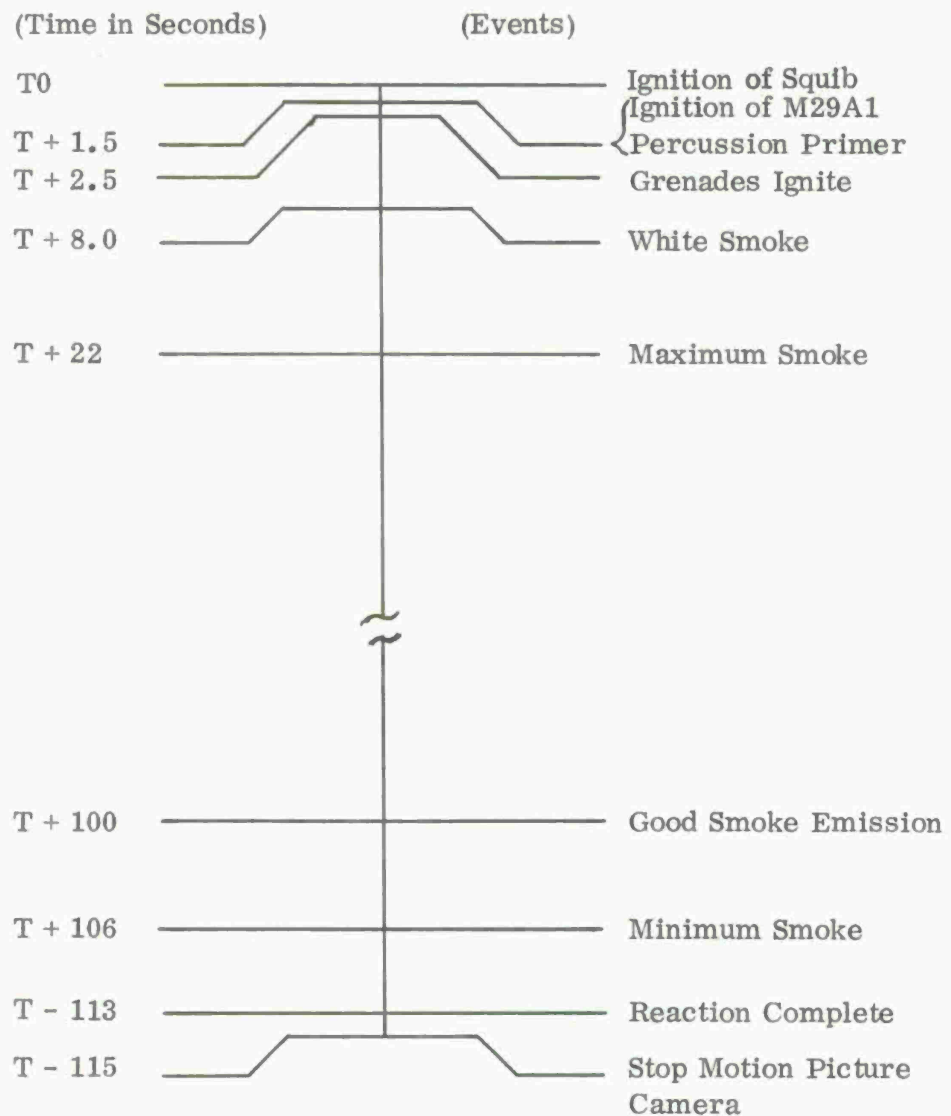
Assigned Classification

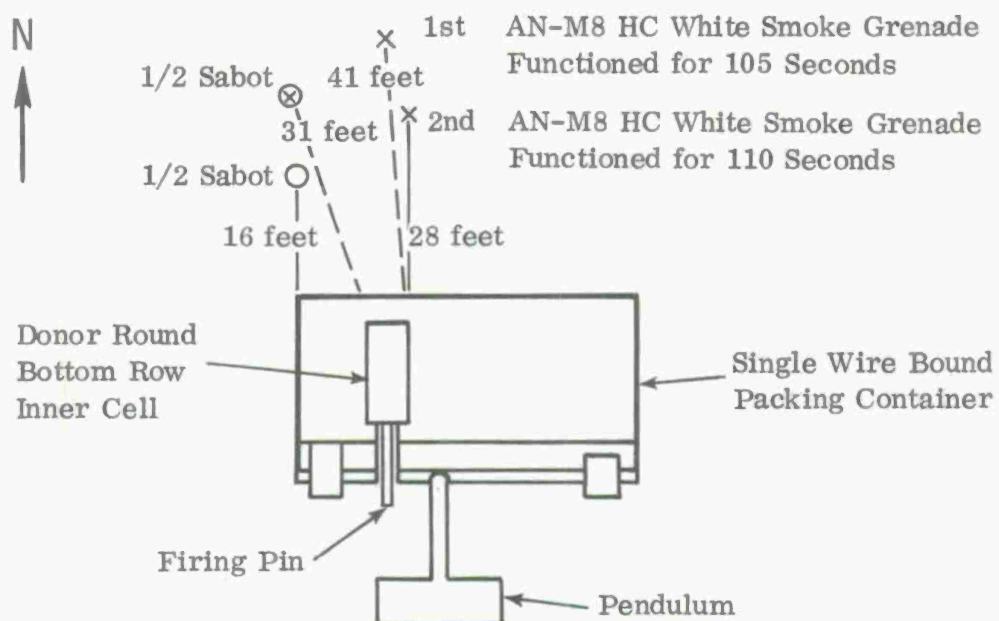
ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

Signature
Title
Organization

*Shipping instructions are to be obtained from ICC Para. 3-13A(2)

CHRONOLOGY OF EVENTS
 HC, M-226, GRENADES AND LAUNCHER
 TEST NUMBER 11-5-04, DETONATION TEST "A" SELF PRIMED





RESULTS OF STANDARD END ITEM DEONTATION TEST "A"
INITIATION BY PENDULUM STRIKER OF DONOR ROUND

Test Type Standard TB 700-2 Detonation "B" Test*		Date 3-13-75	
Sponsoring Agent Edgewood Arsenal, Edgewood, Maryland		Test Number 11-5-05	
Contract Number NAS8-27750		Designation HC, M226 Rocket Launcher	
Specification 1330-00-103-0694		Drawing Number N/A	
Lot Number PB1-1		Manufacture Date 12/74	
METEOROLOGICAL DATA			
Temperature 75 ⁰ F	Humidity 79%	Barometric Pressure 29.62	
Wind Direction 155 ⁰		Wind Velocity 12 Knots	
TEST SET UP			
Priming Self		Location of perceptor Donor 2nd from left bottom row (round oriented north)	
Booster None		Confinement None	
TEST RESULTS			
Detonation Test A		Detonation Test B	
Propagation		Explosion	
Yes No		Yes No X	
Attachments	Photo _____ Map _____ Blast Press. _____	Attachments	Photo _____ Map _____ Blast Press. _____
Test Conductor		Project Engineer F. L. McIntyre	
		Test Dept. Head	

*Self primed impact of M29A1 percussion primer.

Assigned Classification

ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

Signature
Title
Organization

*Shipping instructions are to be obtained from ICC Para. 3-13A(2)

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